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(54) **A method for the decorative printing of surfaces, particularly of tiles and the like, and a machine devised for implementing the method of the invention**

(57) A method for the decorative printing of surfaces, particularly of tiles and the like is described; the method provides for a colouring substance to be sprayed in a jet through a nozzle (7) onto a surface (2)

to be decorated, and the colouring substance is transferred to the surface (2) by directing the flow of the jet by means of a mask (16) interposed between the nozzle (7) and the surface (2).

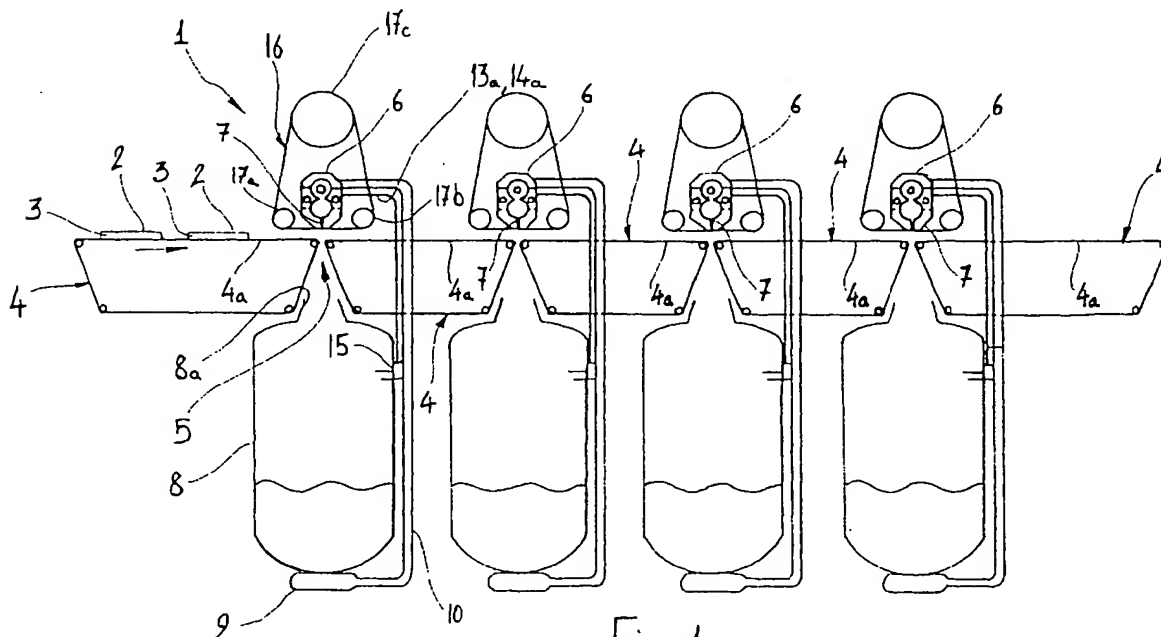


Fig. 1

Description

[0001] The present invention relates to a method for the decorative printing of surfaces, particularly of tiles and the like, according to the preamble to the main claim. A further subject of the invention is a machine devised for implementing the method of the invention.

[0002] The invention has been devised, in particular but not exclusively, for the decorative printing of surfaces of tiles but may be applied equally advantageously in any field in which decorative characters or figures are to be printed on surfaces of products.

[0003] In the specific technical field of tile decoration, the so-called "contact" printing method, which provides for contact to take place between the printing means and the surface of the tile, is known. The contact printing technique has some limitations due mainly to the fact that the printing is greatly affected by the nature of the surface of the tile. In fact if this surface is moist or wet, the colouring substance is not transferred adequately to the surface whereas, on the other hand, with dry surfaces there is a risk of too rapid a transfer of the colouring substance with an excessive absorption effect. Another limitation of contact printing is that, in the edge portions of the tile, which are generally chamfered, the printing cannot be performed effectively owing to the lack of contact of the printing head with the surface of the tile.

[0004] In a more general field, the so-called ink-jet printing technique which permits printing on surfaces without contact between the surface and the printing means is also known. This technique provides for selective spraying, through one or more nozzles provided on the printing head, of ink in the form of minuscule drops which dry upon contact with the air, building up the character or printed decorative figure by dots. This technique, of which, however, there are no known applications in the field of tile decoration, has some limitations to its application in the specific technical field of the present invention. In particular, since the nozzle-bearing head is typically moved relative to the printing surface to reach the positions in which to spray the ink, fast printing speeds comparable to the production rates reached for tiles nowadays could not generally be achieved.

[0005] The object of the present invention is to overcome the problems mentioned with reference to the prior art by means of a method for the decorative printing of surfaces which overcomes the above-mentioned problems connected with contact printing and at the same time ensures printing speeds adequate for the production rates which can be achieved nowadays for tiles.

[0006] In order to achieve the objects indicated above, the subject of the present invention is a method for the decorative printing of surfaces of tiles and the like, the characteristics of which are indicated in Claims 1 to 6 below

[0007] The present invention also relates to a ma-

chine which has been devised specially for implementing the method of the invention and the characteristics of which are indicated in Claims 7 to 15.

[0008] The characteristics and advantages of the invention will become clearer from the detailed description of a preferred embodiment thereof, described by way of non-limiting example with reference to the appended drawings, in which:

Figure 1 is a schematic view of four machines arranged in series for the decorative printing of surfaces of tiles, operating according to the method of the present invention.

Figure 2 is a plan view of a detail of the machines of Figure 1,

Figure 3 is a perspective view of a further detail of the machines of the previous drawings, on an enlarged scale.

[0009] With reference to the drawings mentioned, a machine, generally indicated 1, is for the decorative printing of a surface 2, particularly one of the opposed surfaces of a tile 3, according to the method of the present invention. Figure 1 shows four machines 1 arranged in series, only one of which will be described in detail below.

[0010] The machine 1 comprises a pair of endless conveyor belts 4 each of which has an upper pass 4a on which the tile 3 is transported. The upper passes 4a of the two conveyor belts 4 are aligned with one another and spaced apart, a gap 5 being defined between them.

[0011] The machine 1 also comprises a printing head, generally indicated 6, by means of which a colouring substance, for example enamel, paint, or another coloured pigment, is sprayed onto the surface 2 of the tile. The printing head 6 is fixed to a framework 1a of the machine and has a nozzle 7 having a substantially rectangular outlet section 7a which is elongate along a major axis (Figure 2). The nozzle 7 faces the conveyor belts 4 and is arranged in vertical alignment with the gap 5 between the conveyors.

[0012] On the opposite side of the conveyors 4 to the head 6, the machine comprises a reservoir 8 for holding the colouring substance, the reservoir having an upper opening 8a aligned vertically with the nozzle 7 and the gap 5. In the bottom of the reservoir 8, at the opposite end to the opening 8a, there is a pump 9 for pumping the colouring substance through a duct 10 to the printing head 6.

[0013] A first chamber 11 defined in the printing head 6 is supplied with the colouring substance under pressure through the duct 10 and is in communication with a second chamber 12 which in turn is in communication with the nozzle 7. The second chamber 12 serves to bring about partial expansion of the colouring substance before it is expelled through the nozzle 7.

[0014] Two cavities 13, 14 defined in the head 6 upstream and downstream of the nozzle 7 are in commu-

nication with respective ducts 13a, 14a the opposite end of which are connected to the reservoir 8 by means of a pump 15. The pump 15 serves to create a partial vacuum in the ducts 13a, 14a so as to draw in through the cavities 13, 14 the quantity of colouring substance which is sprayed by the nozzle but is not deposited on the tile 3, and to convey it back to the reservoir 8.

[0015] The machine according to the present invention further comprises a ribbon-like mask, indicated 16, which extends in a closed loop around a set of three guiderollers 17a, 17b, 17c between which three respective portions 18a, 18b, 18c are defined. The portion 18a defined between the rollers 17a, 17b is interposed between the head 6 and the conveyors 4 in a manner such that it is disposed between the nozzle 7 and the surface 2 of the tile, in operation.

[0016] The ribbon-like mask 16, which is preferably made of metal, has a plurality of through-holes 19 in a substantially matrix-like arrangement, some of the holes being blocked in accordance with a preselected configuration correlated with a corresponding decorative figure to be produced by printing on the tile 3. The ribbon-like element 16 is driven around the guide rollers 17a, 17b, 17c in a manner such that the portion 18a performs a translational movement relative to the printing head 6. During its movement relative to the head 6, the mask 16 is struck by the jet of colouring substance which is sprayed through the nozzle 7 and is directed onto the surface 2 of the tile through the holes 19, thus printing the preselected decorative figure. Preferably, the tile 3 is carried by the conveyor belts 4 with a translational movement synchronous with the movement of the ribbon-like mask 16 and the jet of colouring substance is sprayed through the nozzle 7 continuously, without interruption, during the passage of the tile beneath the printing head 6.

[0017] The colouring substance is thus directed onto the surface 2 of the tile through the holes 19, which interfere with the flow of colouring substance expelled by the nozzle 7 during the passage of the mask beneath the printing head. It will be noted that the elongate shape of the nozzle 7 enables the colouring substance to be sprayed simultaneously over the entire transverse dimension of the tile, with reference to the direction of advance of the mask.

[0018] There is also provision for the ribbon-like mask 16 to be replaceable by other masks, each having an arrangement of partially-blocked holes which is representative of a corresponding decorative figure to be printed.

[0019] A device which is not shown and is not a subject of the present invention is provided for converting the preselected decorative figure into a configuration of partially-blocked through-holes for a respective mask such as to reproduce the figure on the surface of the tile during printing.

[0020] Figure 1 shows a plant comprising four machines formed in accordance with the present invention,

arranged in series. This arrangement may be provided, for example, for colour printing of tile surfaces when, in each machine 1 there is provision for a step to print a respective colour or a portion of the whole decorative figure to be printed on the tile.

[0021] The method according to the present invention provides for the tiles 3 to be carried by the belts 4 from the first machine to the fourth machine with a translational movement synchronous with the relative movement of each respective ribbon-like mask 16. In the region of each printing head 6, the method provides for the colouring substance sprayed by the respective nozzle 7 to be directed onto the surface 2 of the tile through the corresponding ribbon-like mask 16. Since, during the movement of the tiles past the printing heads 6, the colouring substance is sprayed continuously and in potentially excessive quantities, the excess quantity of colouring substance which is not transferred to the tile is recovered, on the one hand, by falling into the reservoir 8 through the gap 5 and the opening 8a of the reservoir and, on the other hand, by suction thereof into the cavities 13, 14 and subsequent transportation to the reservoir 8.

[0022] The invention thus solves the problem set, achieving many advantages in comparison with known solutions.

[0023] In the first place, the method and the machine according to the invention enable printing to be carried out on tile surfaces without any contact between the surface and the printing head so that the nature of the surface has no effect on the type of writing or decoration produced. The absence of contact with the surface of the tile also advantageously permits fast printing speeds and enables improved and more accurate control of the speed and synchronism in the movement of the tile and of the ribbon-like mask to be achieved, owing to the absence of friction.

[0024] Another advantage is that the contactless printing which can be achieved by the method and the machine of the invention enables the chamfered edges of the tiles to be printed effectively so that any curvature of the edge relative to the remaining surface has no effect. All of the problems connected with contamination caused by the substance, whether it be enamel, paint, or colouring pigment of another type, between one printing head and the next are also advantageously prevented. Not the least advantage is that, since the printing head in the machine of the invention is fixed and the ribbon-like mask is in motion relative to the head, all of the problems connected with the speed and accuracy of positioning of the head which are typical of known printing machines are overcome.

55 Claims

1. A method for the decorative printing of surfaces, particularly of tiles and the like, in which there is pro-

vision for a colouring substance to be sprayed in a jet through a nozzle (7) onto a surface (2) to be decorated, characterized in that the colouring substance is transferred to the surface (2) by directing the flow of the jet by means of a mask (16) interposed between the nozzle (7) and the surface (2).

2. A method according to Claim 1, in which the surface (2) is moved relative to the jet of colouring substance with preselected rules of movement, and the mask (16) is moved relative to the jet with preselected rules of movement correlated with the rules of movement of the surface (2).
3. A method according to Claim 1 or Claim 2, in which the surface (2) and the mask (16) are moved with synchronous rules of movement.
4. A method according to any one of the preceding claims, in which the jet is continuous and potentially excessive, the excess quantity being at least partially recovered by suction in the region of the mask (16).
5. A method according to one or more of the preceding claims, in which the mask (16) is formed as a closed loop.
6. A method according to one or more of the preceding claims, in which there is provision for the printing of a plurality of surfaces (2) moved in sequence, the jet of the colouring substance being uninterrupted between the printing of one surface (2) and the next.
7. A machine for the decorative printing of surfaces, particularly of tiles and the like, comprising at least one printing head (6) including at least one nozzle (7) for spraying a colouring substance onto a surface to be decorated, characterized in that it comprises a mask (16) interposed between the nozzle (7) and the surface (2) for directing the jet of the substance onto the surface (2) in accordance with the method of one or more of the preceding claims.
8. A machine according to Claim 7, comprising first feed means (4) for moving the surface (2) relative to the nozzle (7) with preselected rules of movement, and second feed means (17a, b, c.) for moving the mask (16) relative to the nozzle (7) with preselected rules of movement correlated with the rules of movement of the surface (2).
9. A machine according to Claim 8, in which the movements of the surface (2) and of the mask (16) are synchronous.
10. A machine according to any one of Claims 7 to 9, in which the jet of the colouring substance sprayed

by the nozzle (7) is continuous and tends to be excessive, auxiliary pumping means (15) being provided on the printing head (6) for drawing in at least some of the excess quantity in the region of the mask (16).

11. A machine according to one or more of Claims 7 to 10, in which the mask (16) is formed as a closed loop.
12. A machine according to Claim 11, in which the mask (16) is ribbon-like.
13. A machine according to any one of Claims 7 to 12, in which the mask (16) has a plurality of through-holes (19), the arrangement of the holes being correlated with a respective decorative figure to be printed on the surface (2) so that the decorative figure is printed on the surface by means of the jet of the colouring substance sprayed by the nozzle (7) and directed onto the surface (2) by means of the mask (16).
14. A machine according to one or more of Claims 7 to 13, in which the nozzle (7) comprises an expulsion cross-section (7a) which is elongate along a major axis.
15. A machine according to one or more of Claims 7 to 14, comprising a reservoir (8) for collecting the colouring substance, the reservoir (8) being supplied at least partially by dropping of the excess quantity of the substance sprayed and not transferred onto the surface (2).
16. A machine according to one or more of Claims 7 to 15, in which the printing head (6) comprises a first chamber (11) for collecting the colouring substance and a second chamber (12) in communication with the first chamber (11) and with the nozzle (7).
17. A machine according to Claim 10, in which the auxiliary pumping means are provided upstream and/or downstream of the nozzle (7).
18. A machine according to Claim 17, in which the auxiliary pumping means comprise a pump (15) producing a partial vacuum in order to draw in the excess quantity of the colouring substance sprayed onto the printing surface (2) and to convey it to the collection reservoir (8).

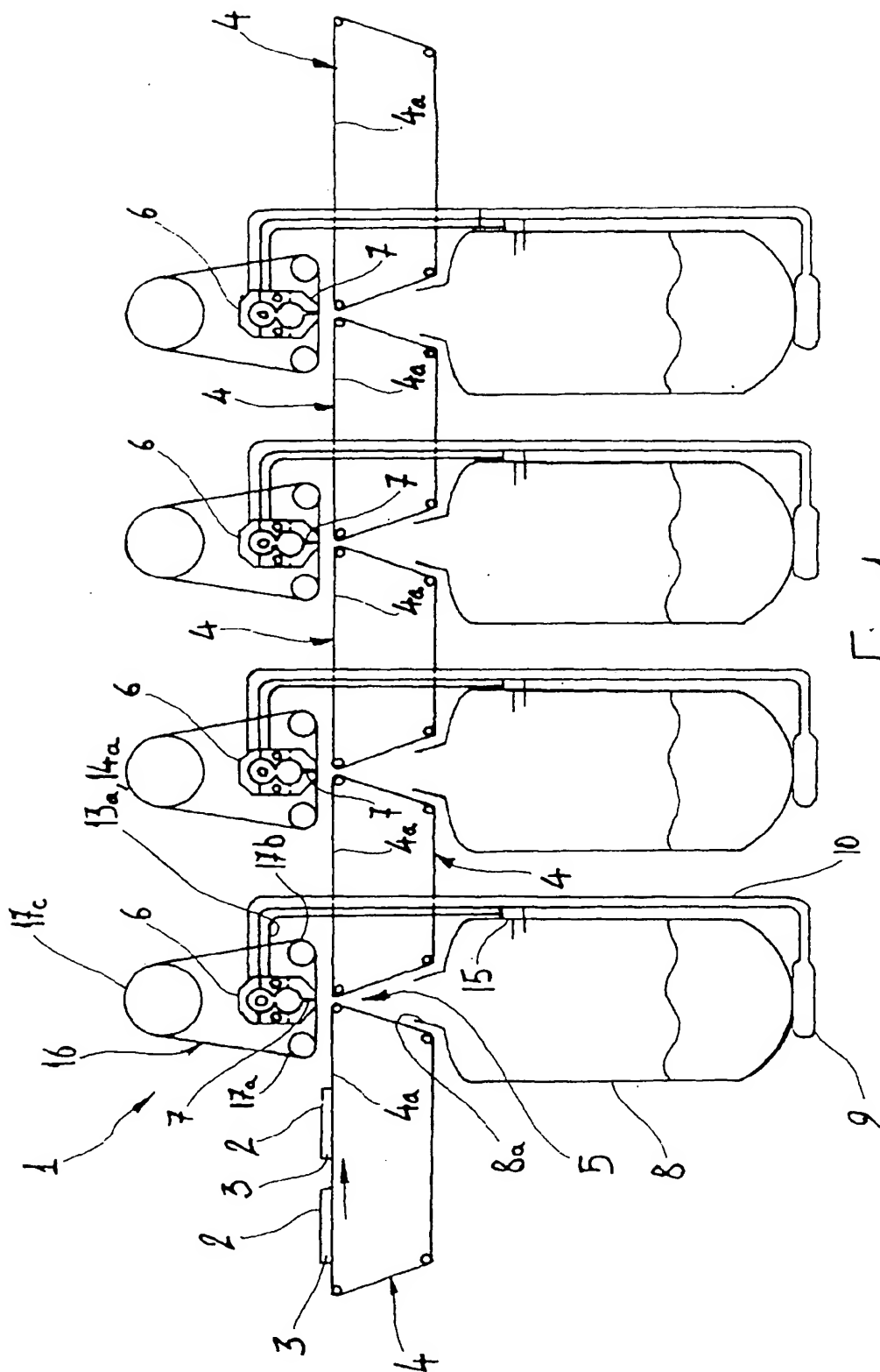
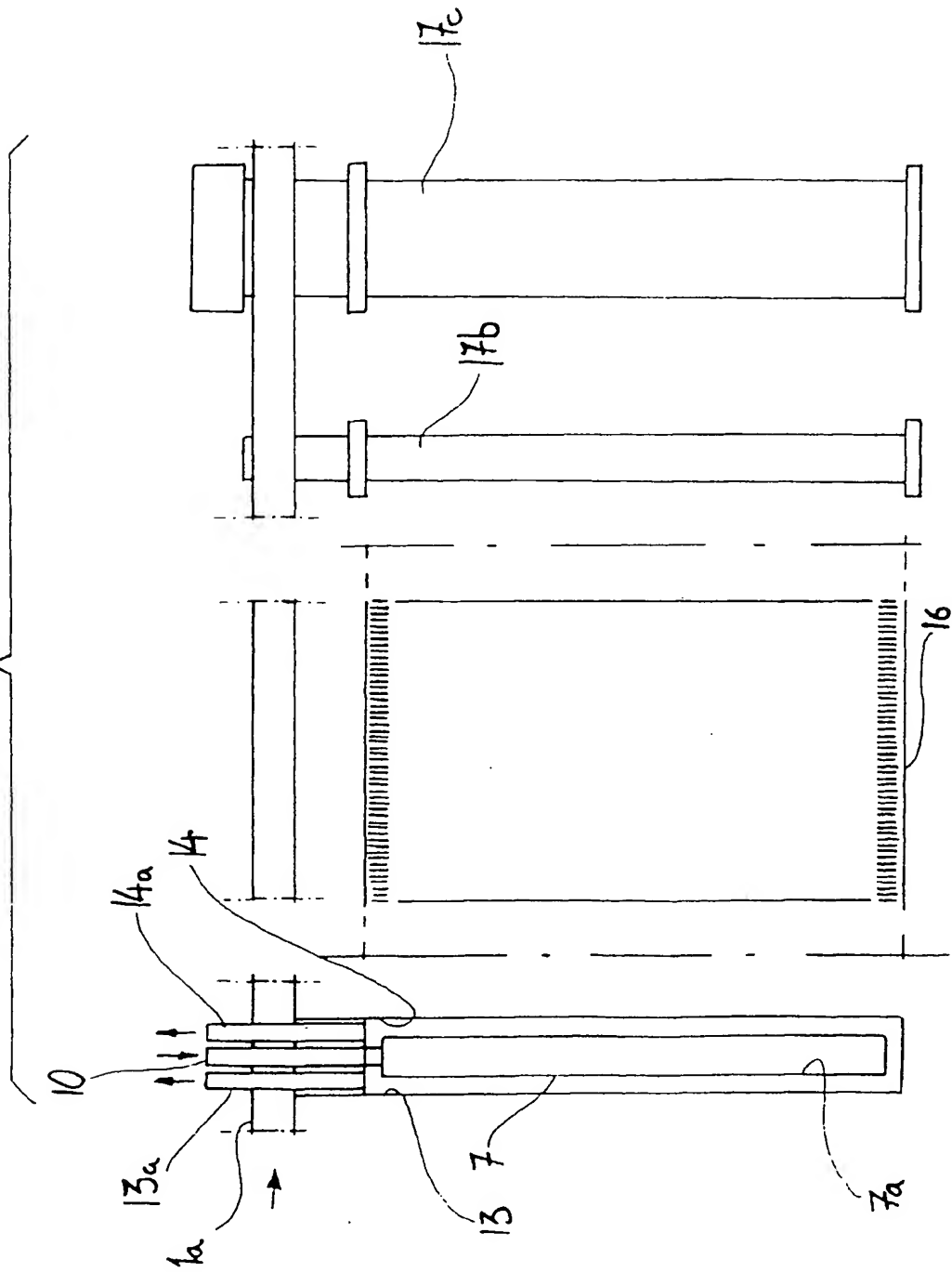


Fig. 1

Fig. 2



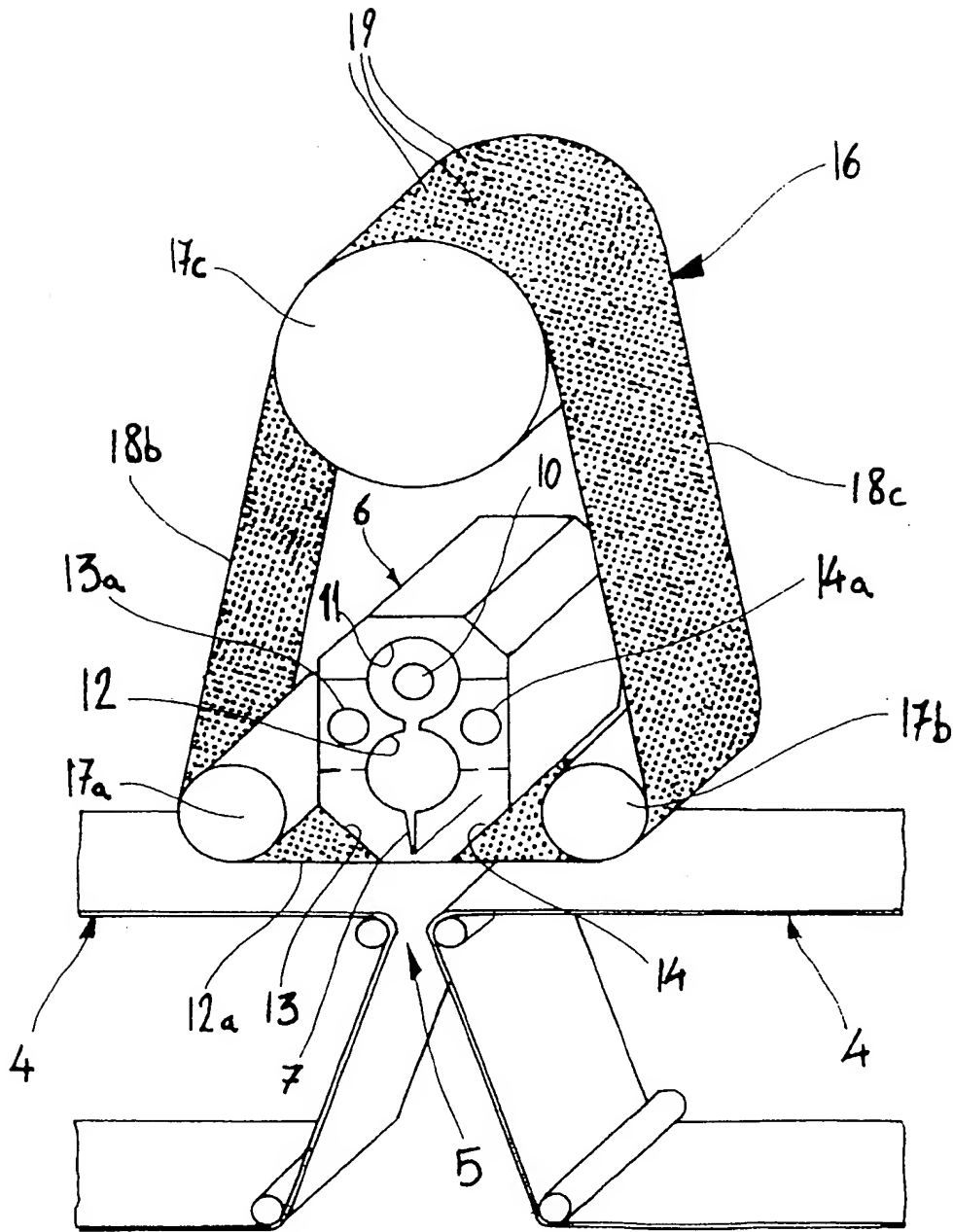


Fig. 3



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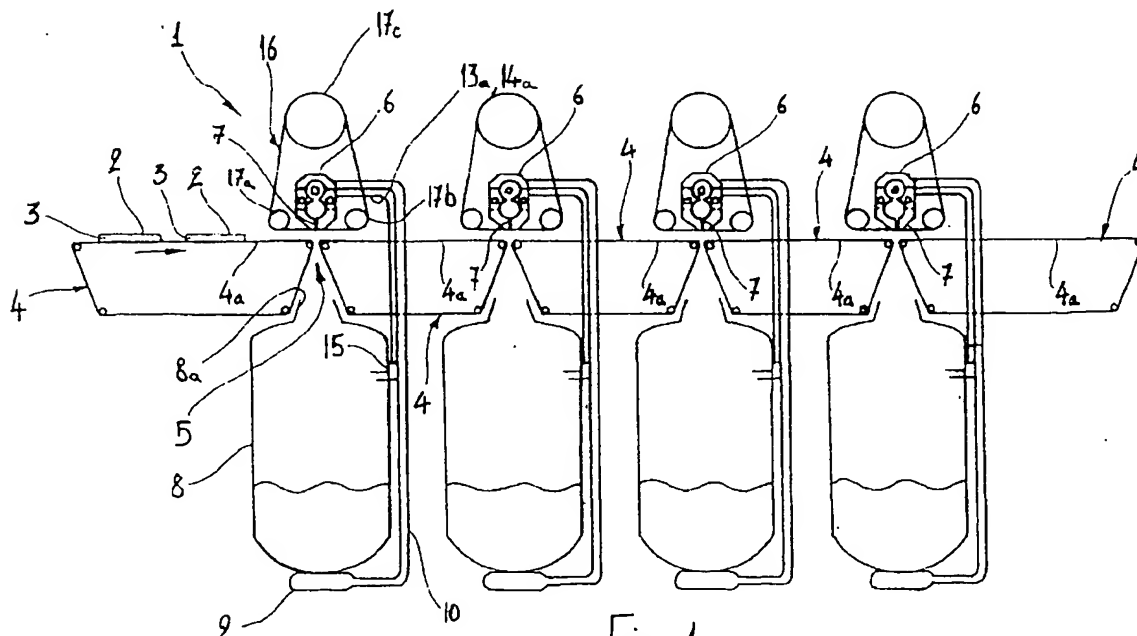


Fig. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 99 83 0428

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	WO 95 18020 A (ALGERI MARIS ; CAMORANI CARLO ANTONIO (IT)) 6 July 1995 (1995-07-06) * the whole document *	1-15	B28B11/04 B05B15/04 B05B13/02
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B05B B28B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
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